Computer Network Project

Group students:

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Introduction

Seeing how your network operate is important task to evaluate how your data is transferring between the networks and if it has traffic congestion or delays or any problems could make an issue through the process and is it reliable data transfer , this project contain many measures that will show the network performance such as throughput and latency , and capturing network packets and logs and will plot the results using python and other library to analyze the packets .

Project outline

This project's main goal is:

- Record and capture detailed packet and log information.
- Determine and present network performance metrics, including latency and throughput.
- Graphs can be used to visualize network data.
- The Resources and Libraries that being used:
  Scapy: For analyzing networks and sniffing packets.
  Matplotlib: To create visual representations.
  Standard libraries for Python: Threading, logging, and signal handling are all included for termination and real-time performance.

Function used :

Part A is about Packet capturing :

handle_ packet (packet) : Captures packets from Ethernet, IP, TCP, and UDP layers.

Retrieves and logs details:

Source and destination MAC/IP addresses.

Packet size and protocol type.

Stores unique MAC and IP addresses in sets.

Part B is about system logging

log_packet(protocol, src, dest, size): Logs packet records into network_events.log.

Includes : Timestamp, Protocol (Ethernet, IP, TCP, UDP), Source/Destination addresses, and Packet size.

The created file will be : network_events.log: Contains all logged packet details with timestamps.

Part C is about Throughput calculation:

calculate throughput(interval=10) periodically : Calculates the amount of data processed (bps) for each protocol every 10 seconds.

The calculation is based on this mathematical formula : Throughput (bps) = (Total Bytes Captured * 8) / Time Interval

Part D is about Latency Measurement :

calculate_latency(): Tracks the latency for each TCP/UDP connection.

Computes latency in milliseconds and averages across all connections.

The calculation is based on this mathematical formula : Latency (ms) = (Response Timestamp - Request Timestamp) * 1000

Part E is about Real – Time Statistics :

real_time_stats(interval=30): Displays real-time network statistics every 30 seconds:

Unique MAC and IP addresses.

Total packets captured.

Part F is about Results Visualization:

plot_results(): will generates the following graphs:

Throughput Over Time

Latency Distribution

Protocol Usage

The results of these plots in the results section down below

Part G: Packet Sniffing

Start_sniffing():method is used to begin sniffing network packets.

For each packet that is generated, handle_packet() is called in order to process and record information .

Part H is about Termination :

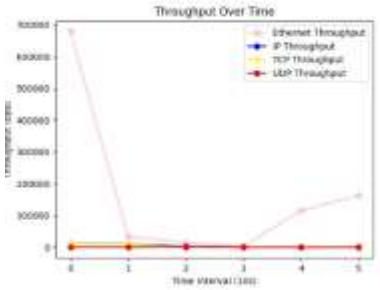
stop_sniffing(signal, frame): Handles Ctrl+C to stop packet capture.

Final statistics and graphs are displayed before exiting.

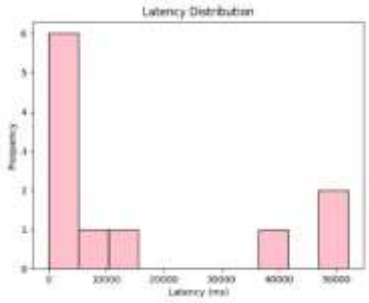
Results (including screenshots and graphs).

- **Throughput Over Time:**

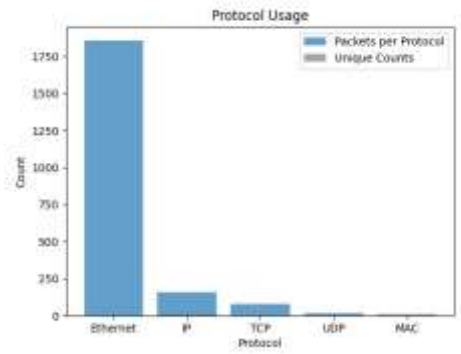
A plot Showing the Ethernet, IP, TCP, and UDP protocols' data rates over time. This makes the network's traffic patterns easier to see.



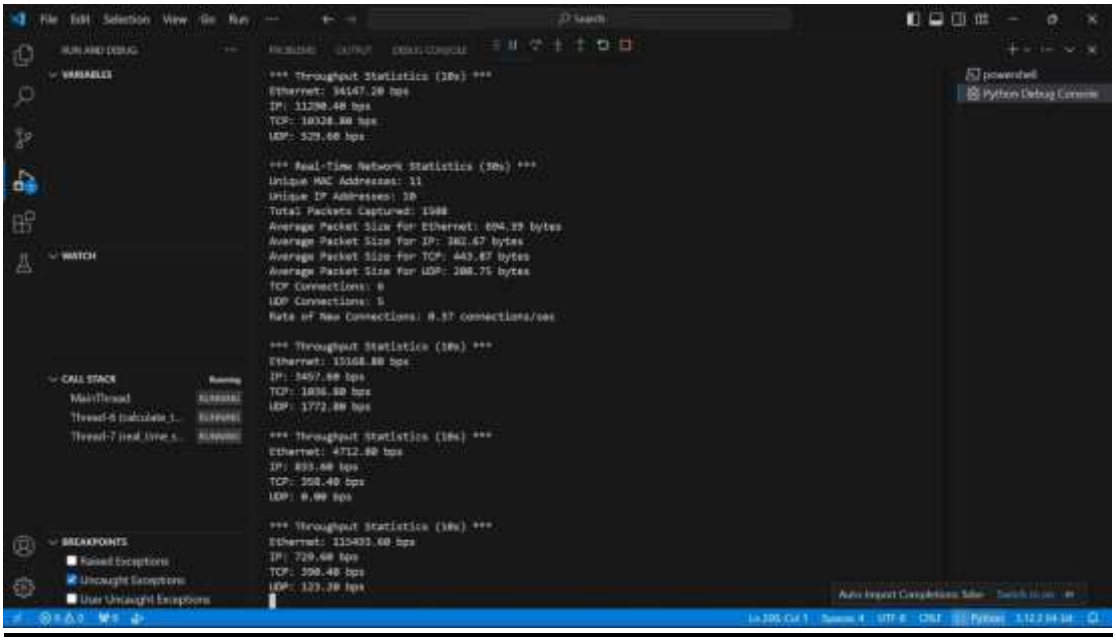
- **Latency Distribution:**
  It is a histogram showing the distribution of delays in TCP and UDP packet exchange. It simplifies network delay analysis.



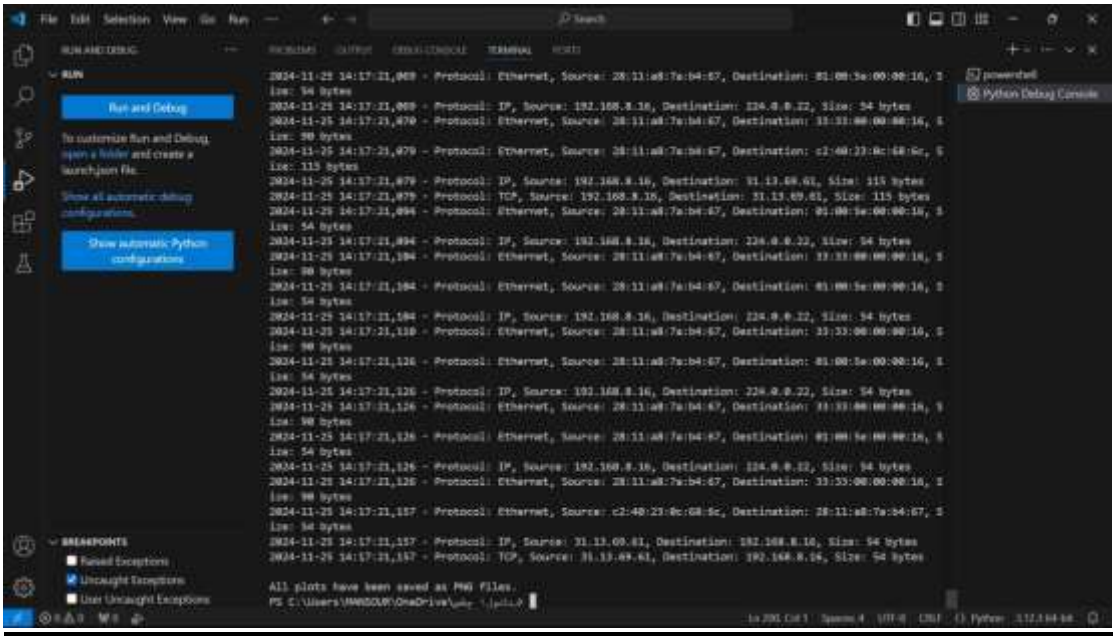
- **Protocol Usage:** A bar graph that displays the total amount of packets sent by each protocol (IP, TCP, UDP, Ethernet), plus the number of unique MAC and IP addresses.



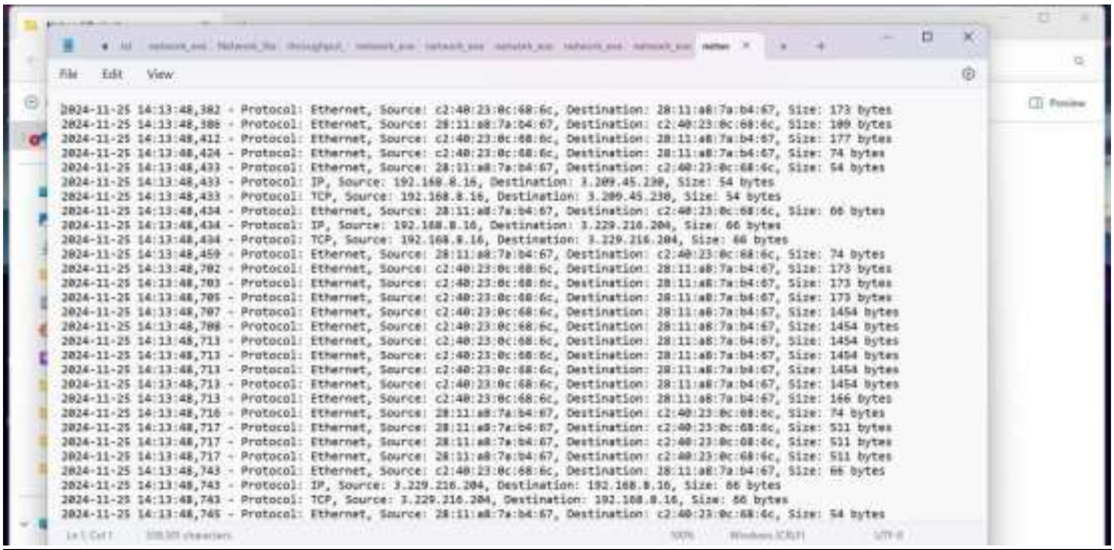
The output of code (sniffer) :



Reading from the file:



Network events log:



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2024-11-25 14:13:48,382 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 173 bytes
2024-11-25 14:13:48,386 - Protocol: Ethernet, Source: 28:11:a8:7a:b4:67, Destination: c2:40:23:0c:68:6c, Size: 108 bytes
2024-11-25 14:13:48,412 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 177 bytes
2024-11-25 14:13:48,424 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 74 bytes
2024-11-25 14:13:48,433 - Protocol: Ethernet, Source: 28:11:a8:7a:b4:67, Destination: c2:40:23:0c:68:6c, Size: 54 bytes
2024-11-25 14:13:48,433 - Protocol: IP, Source: 192.168.8.16, Destination: 3.209.45.230, Size: 54 bytes
2024-11-25 14:13:48,433 - Protocol: TCP, Source: 192.168.8.16, Destination: 3.209.45.230, Size: 54 bytes
2024-11-25 14:13:48,434 - Protocol: Ethernet, Source: 28:11:a8:7a:b4:67, Destination: c2:40:23:0c:68:6c, Size: 66 bytes
2024-11-25 14:13:48,434 - Protocol: IP, Source: 192.168.8.16, Destination: 3.229.216.204, Size: 66 bytes
2024-11-25 14:13:48,434 - Protocol: TCP, Source: 192.168.8.16, Destination: 3.229.216.204, Size: 66 bytes
2024-11-25 14:13:48,459 - Protocol: Ethernet, Source: 28:11:a8:7a:b4:67, Destination: c2:40:23:0c:68:6c, Size: 74 bytes
2024-11-25 14:13:48,702 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 173 bytes
2024-11-25 14:13:48,703 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 173 bytes
2024-11-25 14:13:48,705 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 173 bytes
2024-11-25 14:13:48,707 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 1454 bytes
2024-11-25 14:13:48,708 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 1454 bytes
2024-11-25 14:13:48,713 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 1454 bytes
2024-11-25 14:13:48,713 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 1454 bytes
2024-11-25 14:13:48,713 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 1454 bytes
2024-11-25 14:13:48,713 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 1454 bytes
2024-11-25 14:13:48,713 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 166 bytes
2024-11-25 14:13:48,716 - Protocol: Ethernet, Source: 28:11:a8:7a:b4:67, Destination: c2:40:23:0c:68:6c, Size: 74 bytes
2024-11-25 14:13:48,717 - Protocol: Ethernet, Source: 28:11:a8:7a:b4:67, Destination: c2:40:23:0c:68:6c, Size: 511 bytes
2024-11-25 14:13:48,717 - Protocol: Ethernet, Source: 28:11:a8:7a:b4:67, Destination: c2:40:23:0c:68:6c, Size: 511 bytes
2024-11-25 14:13:48,717 - Protocol: Ethernet, Source: 28:11:a8:7a:b4:67, Destination: c2:40:23:0c:68:6c, Size: 511 bytes
2024-11-25 14:13:48,743 - Protocol: Ethernet, Source: c2:40:23:0c:68:6c, Destination: 28:11:a8:7a:b4:67, Size: 66 bytes
2024-11-25 14:13:48,743 - Protocol: IP, Source: 3.229.216.204, Destination: 192.168.8.16, Size: 66 bytes
2024-11-25 14:13:48,743 - Protocol: TCP, Source: 3.229.216.204, Destination: 192.168.8.16, Size: 66 bytes
2024-11-25 14:13:48,745 - Protocol: Ethernet, Source: 28:11:a8:7a:b4:67, Destination: c2:40:23:0c:68:6c, Size: 54 bytes
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Discussion section on the network environment where testing was conducted.

The environment might not accurately reflect the complexity of larger, more dynamic networks because of the small and limited LAN structure. Tests of throughput and latency were carried out in perfect situations, with low interference and stable network performance. Sniffer mode will show you the packet capturing and create the log file to record the event for each protocol, All LAN packets were monitored using sniffer mode which capture each packets and do all the calculation and plot the results , from the results the first plot (Throughput Over Time) Ethernet high throughput at 700,000bps , IP UDP TCP start at 10,000 bps. Second plot (Latency Distribution) it shows that the most latency has occurred in the average rannge 0- 10,0000 ms , the high latency is reached to 50,000ms.Third plot (Protocol Usage) , Ethernet has a High usage with 1750 packets IP 100 packets and TCP 100 packet UDP is less than 50 packets , MAC mini usage less than 10 packets